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**What Factors Influence Emergency Department Visits by Patients with Cancer at the End-of-Life?**

**Analysis of a 124,030 Patient Cohort**

Lesley A. Henson (LH)<sup>1</sup>, Irene J. Higginson (IJH)<sup>1</sup> and Wei Gao (GW)<sup>1</sup> on behalf of BuildCARE

<sup>1</sup>King's College London, Faculty of Life Sciences and Medicine, Department of Palliative Care, Policy & Rehabilitation, Cicely Saunders Institute, London, UK.

**Correspondence to:**

Dr Lesley A. Henson (MBBS, MRCP)

Cicely Saunders Institute, Bessemer Road, London, SE5 9PJ, UK

T: +44 (0) 207 848 5516, F: +44 (0) 207 848 5517

lesley.henson@kcl.ac.uk

**Disclaimers:**

The authors indicate no potential conflicts of interest.

## ABSTRACT

**Background:** Emergency department (ED) visits towards the end-of-life by patients with cancer are increasing over time. This is despite evidence of an association with poor patient and caregiver outcomes and most patients preferring home-based care.

**Aim:** To identify socio-demographic and clinical factors associated with end-of-life ED visits, and determine the relationship between patients' prior ED use and risk of multiple ( $\geq 2$ ) visits in the last month of life.

**Design:** Population-based cohort study.

**Setting/Participants:** All adults who died from cancer, in England, between 01/04/2011 and 31/03/2012. Our primary outcome was the adjusted odds ratio for multiple ED visits in the last month of life, derived using multivariable logistic regression.

**Results:** Among 124,030 cancer decedents (52.9% men; mean age 74.1 years), 30.7% visited the ED once in their last month of life and 5.1% visited multiple times. Patients were more likely to visit multiple times if they were men, younger, Asian or Black, of lower socio-economic status, had greater co-morbidity, and lung or head and neck cancer. Patients with  $\geq 4$  ED visits in the 11 months prior to their last month of life were also more likely to make multiple visits during their last 30 days; this followed a dose-response pattern ( $p$  for trend  $< 0.001$ ).

**Conclusion:** Patients with greater co-morbidity, lung or head and neck cancer and a higher number of previous ED visits are more likely to visit the ED multiple times in the last month of life. Previously reported socio-demographic factors (men; younger age; Black; low socio-economic status) are also confirmed for the first time in a UK population.

**KEY WORDS**

Cancer; End of Life Care; Emergency Department; Accident & Emergency; Palliative Care; Health Behaviour.

## **KEY STATEMENTS**

### **What is already known about the topic**

- Emergency department (ED) visits towards the end-of-life by patients with cancer are increasing over time. This is despite:
  - An association with poor patient and caregiver outcomes;
  - The majority of patients preferring home-based care; and,
  - Most ED's facing significant financial and capacity constraints.

### **What this paper adds**

- This study identifies socio-demographic (male sex; younger age; Asian or Black ethnicity; lower socio-economic status) and clinical factors (greater co-morbidity; diagnosis of lung or head and neck cancer) associated with an increased odds of multiple ( $\geq 2$ ) ED visits by patients with cancer in the last month of life.
- Patients with a higher number of previous ED visits were also found to have a greater odds of multiple ED visits in the last month of life (adjusted odds ratio for  $\geq 7$  previous visits 1.81, 95% confidence interval 1.58-2.07, reference no visits); this followed a dose-response pattern ( $p$  for trend  $< 0.001$ ).

### **Implications for practice, theory or policy**

- These findings can help healthcare professionals, managers and policy-makers to identify patients at increased risk of multiple ED visits towards the end-of-life, therefore allowing additional support services and/ or alternative care pathways to be provided.
- Further research exploring the mechanism of action for the risk factors identified is required.

## INTRODUCTION

In 2012, an estimated 8.2 million people died from cancer worldwide.(1) Population growth and ageing mean that global cancer mortality is expected to rise further, increasing to an anticipated 14.6 million deaths by 2035.(1) Issues pertaining to end-of-life care are consequently affecting a greater number of cancer patients each year and the importance of providing high-quality care, in accordance with patients' needs and preferences, is increasingly recognised.(2)

Towards the end-of-life people with cancer wish to be comfortable, spend time with their loved ones and have access to emotional and spiritual support as required (3-5). Most (64-84%) prefer to be cared for and die at home (6-9), and to avoid overly 'aggressive' care, which can be defined as care that focuses mostly or exclusively on disease-modifying treatments at the expense of good symptom management and/ or advance care planning (4, 10, 11). In addition to patients' preferences, studies have found overly aggressive end-of-life cancer care to be associated with poor patient and caregiver outcomes, including prolonged pain, overall dissatisfaction with care and more than three times the odds of psychiatric illness in bereaved relatives (12-14).

Less is known about the factors that may influence aggressive end-of-life cancer care. Quantifying the aggressiveness of end-of-life cancer care is in itself challenging. Disease-related complications, adverse effects of treatment and/ or unrelated health conditions are all commonly experienced by patients with advanced cancer. To be optimally managed many of these situations require hospital-based care. Deciding which hospital visits represent high-quality care versus those that signify overly aggressive care is complicated: good quality care for one patient may be considered overly aggressive by the next. To address this issue, Earle and colleagues developed a set of quality indicators which at a population-level could be used to identify healthcare systems delivering overly aggressive end-of-life cancer care (11, 15). In 2012, five of these performance measures were endorsed by the National Quality Forum in the United States of America (USA) (16). To date, these measures have not been used to examine the aggressiveness of end-of-life cancer care within the

National Health Service (NHS); a unique healthcare system that provides healthcare free for all at the point of delivery.

This study seeks to understand and improve the quality of end-of-life cancer care by focusing on one of these validated performance measures – the proportion of cancer patients with multiple ( $\geq 2$ ) emergency department (ED) visits in the last month of life. This measure was chosen because ED visits often represent patients' first contact with a healthcare professional when experiencing an acute or urgent symptom. This time is therefore critical when deciding factors such as place of care and intensity of treatment(17). Furthermore, ED visits in general and advanced cancer populations are rising (18-21) despite concerns of ED overcrowding and capacity constraints.

In order to develop future services that can effectively reduce avoidable ED visits (whilst also supporting appropriate attendance for those in need), a comprehensive understanding of the factors influencing cancer patients' ED visits is required. Knowledge of such factors could help healthcare professionals identify individuals at increased risk of multiple end-of-life ED visits, therefore allowing additional support services to be provided. In an earlier systematic review we identified 21 factors associated with ED visits by cancer patients in the last month of life (22). Our findings were, however, limited by the high proportion of studies conducted in the USA and Canada, and conflicting results relating to patients' comorbidity, cancer diagnosis and rurality of usual place of residence. In order to address these gaps and allow development of more targeted approaches towards reducing end-of-life ED visits, we conducted a retrospective cohort study of 124,030 cancer decedents in England, UK. The aim of our study was to determine socio-demographic factors and clinical characteristics associated with end-of-life ED visits, and explore the relationship between patients' prior ED use and the risk of multiple ED visits in the last month of life.

## **METHODS**

Our paper is reported following the RECORD statement – a checklist extended from STROBE and specific to reporting of observational studies using routinely collected health data.(23, 24)

Approval for the study was received from NHS Digital (reference number: NIC-223311-Z0B8Q). As all data was pseudonymised, and therefore non-identifiable, no further approvals were required to complete the analysis.

### **Design**

Population-based retrospective cohort study.

### **Data Sources**

We used linked patient-level data from two routinely collected databases: the Office for National Statistics (ONS) Mortality Database and Hospital Episode Statistics (HES) Accident & Emergency Database.(25, 26) The ONS Mortality Database holds information on all UK deaths based on the information collected when a death is registered. It includes the ‘original underlying cause of death’ – that is the medical condition judged as the disease/ injury leading directly to death or circumstances of an accident or violence that resulted in fatal injury.(25) HES Accident & Emergency Database contains detailed patient-level data for all visits to NHS ED’s in England, UK. It includes both clinical data and information regarding the circumstances of a visit, for example date and time.(27) Linking ONS and HES data allows for analysis of patients’ hospital activity prior to death and is possible through matching person identifiable data in ONS with patient identifiers in HES. During the linkage process each record is assigned a match rank between one (best match) and eight (worse match), providing an indication of the level of confidence that the records have been matched correctly. Over 90% of linked ONS-HES records receive a match rank of one (requiring an



exact match of date of birth, sex, NHS number and postcode) or two (requiring an exact match of date of birth, sex and NHS number).(28)

### **Study Cohort**

Our cohort, supplied by ONS, included all adults ( $\geq 18$  years) who died from cancer (International Statistical Classification of Diseases and Related Health Problems 10th Revision (ICD-10) codes for underlying cause of death C00 to C97)(29) in England, during a one year period (01/04/2011 to 31/03/2012) and had a valid record in HES. This cohort was linked to HES Accident & Emergency data for the same year and the preceding year, i.e. 01/04/2010 to 31/03/2012. This allowed us to quantify the number of ED visits each cancer decedent made in their last year of life.

We excluded persons whose usual place of residence was outside England. We also excluded potentially inaccurate cases, including those with a data linkage match rank of three to eight, cases where patient activity was listed in the HES Accident & Emergency Database after the ONS recorded date of death, and cases where the date of death registration was more than one year after the documented date of death.

### **Variables**

#### **Outcome Variable**

Our primary outcome was the number of unplanned ED visits made by patients with cancer during their last month of life, dichotomised for analysis into those with none or one visit versus those with multiple ( $\geq 2$ ) visits.(15) Planned ED visits – defined by HES as ‘subsequent organised visits to the same department and for the same incident as the first visit’ – were excluded (27).

### Explanatory Variables

Models of health seeking behaviour, including those specific to the ED, guided our selection of independent variables.(30, 31) We considered three groups of variables: socio-demographic factors; clinical characteristics; and, patients' prior ED visits.

Socio-demographic factors included sex (female reference), age at death (<65 (reference), 65-74, 75-84 and 85+ years), ethnicity (White (reference), Asian, Black and other), region of England (North East, North West, Yorkshire & Humberside, East Midlands, West Midlands, East of England, London (reference), South East and South West), rurality of patients' usual place of residence (urban - settlements with populations  $\geq 10,000$ ; rural - settlements with populations  $< 10,000$  (reference)), and socio-economic status which we derived from Index of Multiple Deprivation (IMD) quintiles (1 - most deprived; 5 - least deprived (reference)).(32) The IMD is an area based measure of deprivation that uses Lower Super Output Area (LSOA) geography to compare deprivation between neighbourhoods in England.(33)

Clinical characteristics included cancer diagnosis, level of comorbidity and reason for ED visit, i.e. patients' presenting symptom or medical condition. Cancer diagnosis was provided by ONS as an ICD-10 code representing the patients' underlying cause of death and was categorised into 12 groups: lung, breast, colorectal (reference), head and neck, haematological, upper gastrointestinal (including oesophagus and stomach), gynaecological, prostate, urinary tract (including kidney), hepatobiliary, pancreas and other. Similar to previous studies using HES data (34, 35) we calculated patients' level of comorbidity using the Deyo modification of the Charlson comorbidity score with the points for malignant disease deducted.(36, 37) The score was calculated from data supplied by HES and encompassed a time period of up to two years prior to death. Patients were categorised into three groups: those with a comorbidity score of zero (reference), one or two plus. The reason for ED visit was provided by HES as either an ICD-10 code or a HES generated six character code that comprised information about the clinical condition (from 58 possible options), anatomical area and

side of body. These were grouped into 14 categories: respiratory; cardiovascular; diabetes and endocrinology; gastroenterology and hepatobiliary; genitourinary; haematology; ear nose and throat, facio-maxillary, ophthalmology and/or dermatology; neurology; musculoskeletal disorders and/ or injuries; psychiatry and/ or social problems; infection; pain; cancer/ tumour; and, other.

Patients' prior ED use was assessed as a single variable – the total number of ED visits made during the patient's last year of life, excluding those in the last 30 days (reference group zero visits).

### Theoretical Framework

This study was guided by Andersen and Newman's 'Behavioural Model of Health Services Use (38). In this model healthcare use is presented as a function of need, enabling resources and predisposing characteristics. As such we hypothesised that cancer patients' end-of-life ED attendance would be influenced by their clinical characteristics, environmental factors and demographics.

### Statistical Analysis

Counts and percentages were used to describe cancer patients with none, one, or multiple ED visits in the last month of life. The differences between patients with multiple ED visits and without (none or one ED visit combined) were explored using Chi square test. Factors associated with multiple ED visits were investigated using multivariable logistic regression, where we calculated adjusted odds ratios (AORs) and their corresponding 95% confidence intervals (CIs). Based on the findings of our recently published systematic review,(22) the multivariable logistic model included the following variables *a priori*: age; gender; ethnicity; socio-economic status; type of cancer; level of comorbidity. Additional variables were added if significant ( $p < 0.05$ ) at bivariate analysis.

We calculated variance inflation factors (VIFs) to estimate how much of the variance of the regression coefficient was inflated due to correlation between explanatory variables in the model. We considered VIFs  $> 2.5$  to be indicative of multicollinearity.(39) The model's goodness of fit was

assessed using the Hosmer-Lemeshow test.(39) Discrimination performance was calculated as area under the receive operating characteristic (ROC) curve. In this technique, the discrimination of the model is assessed by plotting the sensitivity of the test against 1 minus the specificity. The greater the area under the ROC curve (on a scale of 0.5-1), the better the model's discrimination.

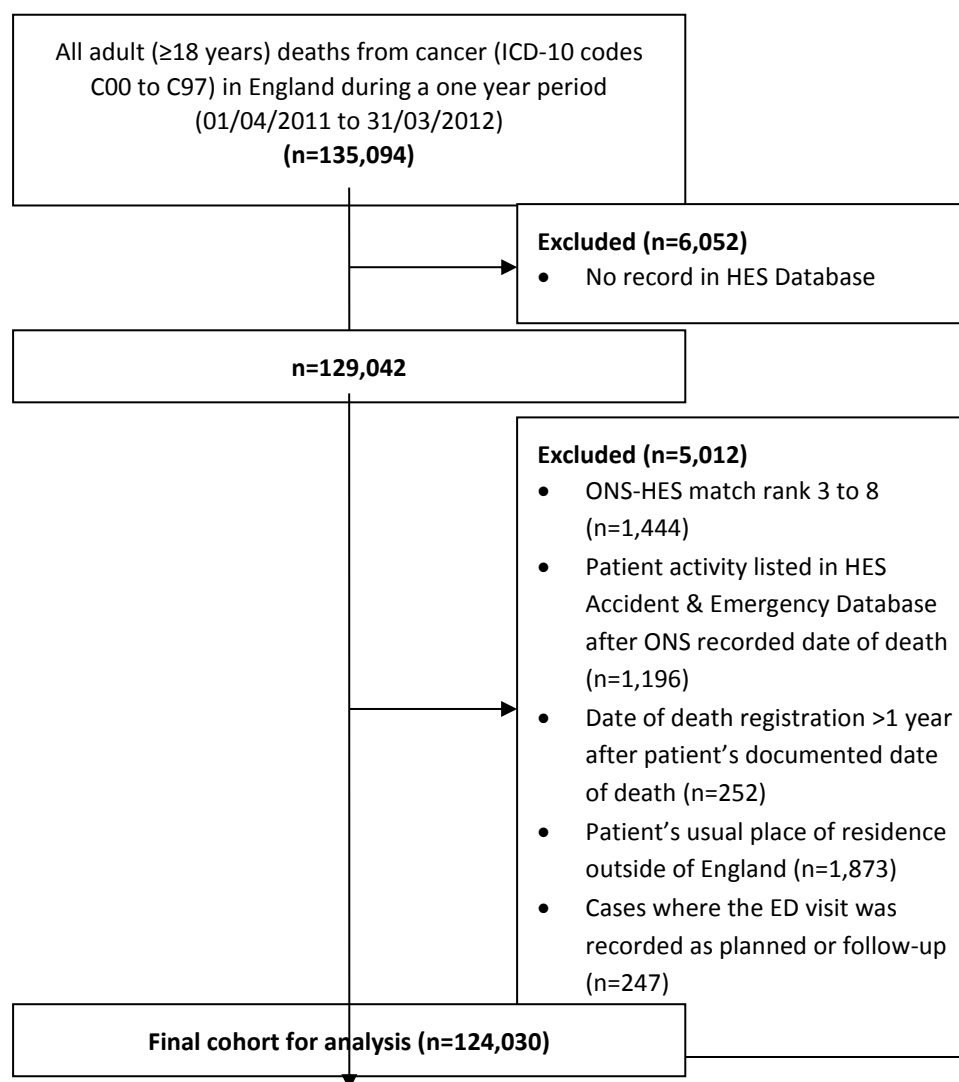
Levels of missing data were examined and as  $\leq 4\%$  complete-case analysis performed.

Stata/IC 13 (STATA, College Station, TX) was used for all statistical analysis.

## RESULTS

Between 01/04/2011 and 31/03/2012, there were 135,094 deaths from cancer in England of which 129,042 (95.5%) had a valid record in HES. Patients with no record in any HES database were considered potentially inaccurate and therefore excluded.(40) A further 5,012 cases were excluded for other reasons (as described in figure 1), leaving 124,030 cases suitable for analysis (figure 1).

**Figure 1: Flow Diagram**



*ICD-10 – International Statistical Classification of Diseases and Related Health Problems 10th Revision, HES – Hospital Episode Statistics, ONS – Office for National Statistics, ED – emergency department*

Among our cohort, mean age at death was 74.1 years (standard deviation 12.6); 52.9% were men.

Almost all were White (96.1%) and the majority lived in an urban setting (78.2%). The most common cause of death was from lung cancer (21.5%) (table 1).

# End-of-Life Emergency Department Visits

**Table 1: Socio-demographic factors and clinical characteristics of study cohort (n=124,030)**

	Total sample	Emergency department visits in last 30 days					
		None		1 visit		≥2 visits	
	N	N	(%)	N	(%)	N	(%)
	<b>124030</b>	<b>79656</b>	<b>64.2</b>	<b>38049</b>	<b>30.7</b>	<b>6325</b>	<b>5.1</b>
<b>Age in years, mean (SD)</b>	<b>74.1 (12.6)</b>	74.2 (12.6)		74.4 (12.3)		72.0 (13.1)	
<b>Age in years</b>							
<65	27528	17592	63.9	8189	29.8	1747	6.4
65-74	31499	20059	63.7	9710	30.8	1730	5.5
75-84	39764	25703	64.6	12233	30.8	1828	4.6
85+	25239	16302	64.6	7917	31.4	1020	4.0
<b>Gender</b>							
Male	65649	40990	62.4	20928	31.9	3731	5.7
Female	58381	38666	66.2	17121	29.3	2594	4.4
<b>Ethnicity</b>							
White	114691	73865	64.4	35058	30.6	5768	5.0
Asian	1793	916	51.1	686	38.3	191	10.7
Black	1486	753	50.7	591	39.8	142	9.6
Other	1383	782	56.5	500	36.2	101	7.3
<b>Cancer type</b>							
Lung	26643	15525	58.3	9347	35.1	1771	6.7
Breast	8852	5909	66.8	2528	28.6	415	4.7
Colorectal	12135	8469	69.8	3234	26.7	432	3.6
Head and Neck	2789	1782	63.9	814	29.2	193	6.9
Haematology	10074	6186	61.4	3379	33.5	509	5.1
Upper GI (inc Oesophagus & Stomach)	12101	7959	65.8	3526	29.1	616	5.1
Gynaecological	5939	4183	70.4	1525	25.7	231	3.9
Prostate	8596	5678	66.1	2517	29.3	401	4.7
Urinary tract (inc Kidney)	7384	4825	65.3	2247	30.4	312	4.2
Hepatobiliary	3835	2462	64.2	1178	30.7	195	5.1
Pancreas	6729	4424	65.8	1977	29.4	328	4.9
Other	18953	12254	64.7	5777	30.5	922	4.9
<b>Comorbidity score<sup>s</sup></b>							
0	52616	36154	68.7	14322	27.2	2140	4.1
1	37973	23675	62.4	12200	32.1	2098	5.5
2+	32053	18879	58.9	11107	34.7	2067	6.5
<b>Number of previous ED visits<sup>+</sup></b>							
0	44329	27333	61.7	15002	33.8	1994	4.5
1	35877	24300	67.7	9928	27.7	1649	4.6
2	20333	13371	65.8	5924	29.1	1038	5.1
3	10692	6914	64.7	3148	29.4	630	5.9
4	5667	3550	62.6	1753	30.9	364	6.4
5	2984	1811	60.7	951	31.9	222	7.4
6	1628	968	59.5	517	31.8	143	8.8
7+	2520	1409	55.9	826	32.8	285	11.3
<b>Socio-economic status (IMD quintile)</b>							
1 – most deprived	23994	14246	59.4	8205	34.2	1543	6.4
2	24534	15178	61.9	7952	32.4	1404	5.7
3	26075	17127	65.7	7732	29.7	1216	4.7
4	25731	17130	66.6	7450	29.0	1151	4.5
5 – least deprived	23612	15914	67.4	6688	28.3	1010	4.3
<b>Region</b>							
North East	7410	4741	64.0	2253	30.4	416	5.6
North West	18003	11014	61.2	5951	33.1	1038	5.8
Yorkshire & Humberside	13347	9267	69.4	3554	26.6	526	3.9
East Midlands	11197	7852	70.1	2932	26.2	413	3.7
West Midlands	13345	8610	64.5	4067	30.5	668	5.0
East of England	13949	8623	61.8	4585	32.9	741	5.3
London	12698	6534	51.5	5028	39.6	1136	9.0
South East	20142	13169	65.4	6035	30.0	938	4.7
South West	13938	9846	70.6	3643	26.1	449	3.2
<b>Rurality*</b>							
Urban	96875	60836	62.8	30717	31.7	5322	5.5
Rural	27071	18759	69.3	7310	27.0	1002	3.7

SD – standard deviation, GI – gastrointestinal, ED – emergency department, IMD – index of multiple deprivation, <sup>s</sup>Comorbidity score based on the Deyo modification of the Charlson comorbidity score with the points for malignant disease deducted, <sup>+</sup>Total number of ED visits in the last year of life excluding the last 30 days. \*Rural - settlements with populations ≥10,000 and urban - settlements with populations <10,000.

In the last month of life, 30.7% (n=38,049) of patients visited the ED once, 4.5% (n=5,561) made two visits, 0.5% (n=654) made three, and 0.1% (n=110) made four or more. The number of visits ranged from 0 to 8 (median 0).

Multivariable analysis found an association between multiple ED visits in the last month of life and the following socio-demographic factors: younger age, male sex (AOR 1.26, 95% CI 1.19–1.34), Asian (1.49, 1.27–1.74) or Black ethnicity (1.21, 1.01–1.46), lower socio-economic status, and living in an urban setting (1.18, 1.10–1.28) (table 2). Patients living in London were significantly more likely to visit the ED multiple times during their last month of life compared to those living in all other regions of England (table 2).

Clinical characteristics associated with multiple ED visits were a greater level of comorbidity and a diagnosis of lung (1.74, 1.56–1.95) or head and neck cancer (1.67, 1.40–2.00) (table 2). For the variable “reason for ED visit” 1,271 patients left of were transferred from the ED before being seen and 1,909 patients either died in the ED or were dead on arrival. After excluding these patients we found respiratory conditions (19.6%), gastrointestinal and hepatobiliary conditions (13.3%), and musculoskeletal disorders/ injuries (including fractures) (11.8%) were most commonly reported. However, this information was not included in our multivariable model due to there also being high levels of missing and/ or invalid data.

A dose-response pattern was found for the association between patients’ prior ED visits and their attendance in the last month of life. Compared to patients with no ED visits in the 11 months prior to the last month of life, the odds of multiple ED visits during their last 30 days increased with each additional visit,  $p$  for trend <0.001 (figure 2).



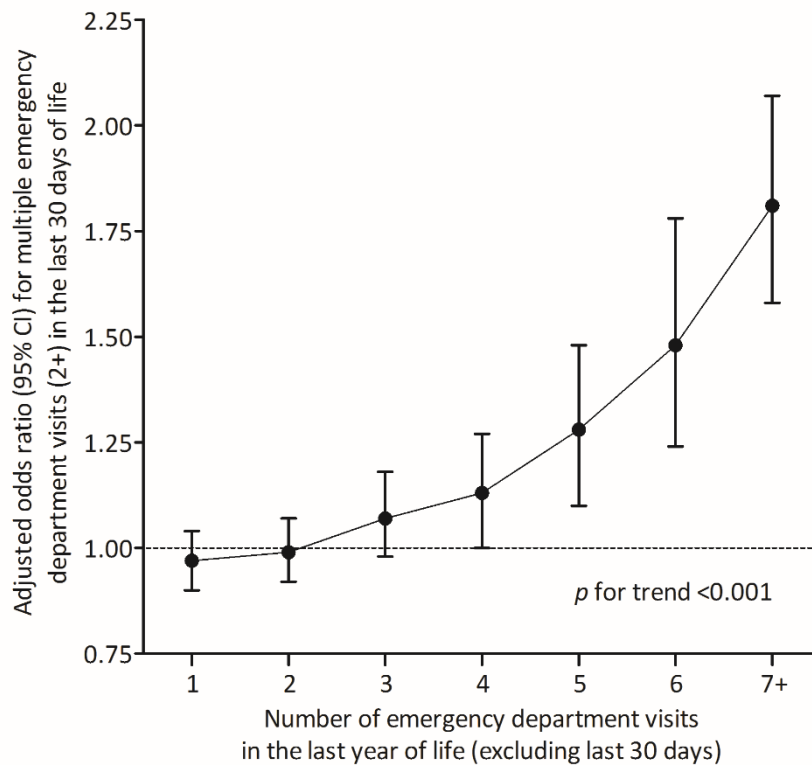
## End-of-Life Emergency Department Visits

**Table 2: Analysis of factors associated with multiple ED visits by patients with cancer in the last 30 days of life (n=124,030)**

Variable	OR	95% CI	AOR	95% CI
<b>Age in years</b>				
<65	1.00	-	-	-
65-74	<b>0.86</b>	<b>0.80 – 0.92</b>	<b>0.85</b>	<b>0.79 – 0.91</b>
75-84	<b>0.71</b>	<b>0.66 – 0.76</b>	<b>0.70</b>	<b>0.65 – 0.75</b>
85+	<b>0.62</b>	<b>0.57 – 0.67</b>	<b>0.65</b>	<b>0.59 – 0.70</b>
<b>Gender</b>				
Female	1.00	-	-	-
Male	<b>1.30</b>	<b>1.23 – 1.36</b>	<b>1.26</b>	<b>1.19 – 1.34</b>
<b>Ethnicity</b>				
White	1.00	-	-	-
Asian	<b>2.25</b>	<b>1.93 – 2.62</b>	<b>1.49</b>	<b>1.27 – 1.74</b>
Black	<b>2.00</b>	<b>1.67 – 2.38</b>	<b>1.21</b>	<b>1.01 – 1.46</b>
Other	<b>1.49</b>	<b>1.21 – 1.82</b>	1.10	0.89 – 1.35
<b>Cancer type</b>				
Lung	<b>1.93</b>	<b>1.73 – 2.15</b>	<b>1.74</b>	<b>1.56 – 1.95</b>
Breast	<b>1.33</b>	<b>1.16 – 1.53</b>	<b>1.49</b>	<b>1.29 – 1.73</b>
Colorectal	1.00	-	-	-
Head and Neck	<b>2.01</b>	<b>1.69 – 2.40</b>	<b>1.67</b>	<b>1.40 – 2.00</b>
Haematology	<b>1.44</b>	<b>1.26 – 1.64</b>	<b>1.32</b>	<b>1.15 – 1.51</b>
Upper GI (inc Oesophagus & Stomach)	<b>1.45</b>	<b>1.28 – 1.65</b>	<b>1.37</b>	<b>1.21 – 1.56</b>
Gynaecological	1.10	0.93 – 1.29	<b>1.19</b>	<b>1.01 – 1.41</b>
Prostate	<b>1.33</b>	<b>1.15 – 1.52</b>	<b>1.21</b>	<b>1.05 – 1.40</b>
Urinary Tract (inc Kidney)	<b>1.20</b>	<b>1.03 – 1.39</b>	1.09	0.94 – 1.27
Hepatobiliary	<b>1.45</b>	<b>1.26 – 1.64</b>	<b>1.20</b>	<b>1.01 – 1.44</b>
Pancreas	<b>1.39</b>	<b>1.15 – 1.52</b>	<b>1.34</b>	<b>1.16 – 1.56</b>
Other	<b>1.39</b>	<b>1.23 – 1.56</b>	<b>1.33</b>	<b>1.18 – 1.50</b>
<b>Comorbidity score<sup>§</sup></b>				
0	1.00	-	-	-
1	<b>1.38</b>	<b>1.30 – 1.47</b>	<b>1.31</b>	<b>1.23 – 1.39</b>
2+	<b>1.63</b>	<b>1.53 – 1.73</b>	<b>1.53</b>	<b>1.43 – 1.63</b>
<b>Previous ED usage<sup>*</sup></b>				
0	1.00	-	-	-
1	1.02	0.96 – 1.09	0.97	0.90 – 1.04
2	<b>1.14</b>	<b>1.06 – 1.23</b>	0.99	0.92 – 1.07
3	<b>1.33</b>	<b>1.21 – 1.46</b>	1.07	0.98 – 1.18
4	<b>1.46</b>	<b>1.30 – 1.64</b>	<b>1.13</b>	<b>1.00 – 1.27</b>
5	<b>1.71</b>	<b>1.48 – 1.97</b>	<b>1.28</b>	<b>1.10 – 1.48</b>
6	<b>2.04</b>	<b>1.71 – 2.44</b>	<b>1.48</b>	<b>1.24 – 1.78</b>
7+	<b>2.71</b>	<b>2.37 – 3.09</b>	<b>1.81</b>	<b>1.58 – 2.07</b>
<b>Socio-economic status (IMD quintile)</b>				
5 – least deprived	1.00	-	-	-
4	1.05	0.96 – 1.14	1.03	0.94 – 1.12
3	<b>1.09</b>	<b>1.01 – 1.19</b>	1.03	0.94 – 1.12
2	<b>1.36</b>	<b>1.25 – 1.48</b>	<b>1.12</b>	<b>1.03 – 1.23</b>
1 – most deprived	<b>1.54</b>	<b>1.42 – 1.67</b>	<b>1.19</b>	<b>1.09 – 1.30</b>
<b>Region</b>				
London	1.00	-	-	-
North East	<b>0.61</b>	<b>0.54 – 0.68</b>	<b>0.66</b>	<b>0.58 – 0.75</b>
North West	<b>0.62</b>	<b>0.57 – 0.68</b>	<b>0.68</b>	<b>0.62 – 0.75</b>
Yorkshire & Humberside	<b>0.42</b>	<b>0.38 – 0.46</b>	<b>0.48</b>	<b>0.43 – 0.54</b>
East Midlands	<b>0.39</b>	<b>0.35 – 0.44</b>	<b>0.47</b>	<b>0.41 – 0.53</b>
West Midlands	<b>0.54</b>	<b>0.49 – 0.59</b>	<b>0.62</b>	<b>0.56 – 0.68</b>
East of England	<b>0.57</b>	<b>0.52 – 0.63</b>	<b>0.72</b>	<b>0.65 – 0.80</b>
South East	<b>0.50</b>	<b>0.45 – 0.54</b>	<b>0.62</b>	<b>0.56 – 0.68</b>
South West	<b>0.34</b>	<b>0.30 – 0.38</b>	<b>0.43</b>	<b>0.38 – 0.49</b>
<b>Rurality*</b>				
Rural	1.00	-	1.00	-
Urban	<b>1.52</b>	<b>1.41 – 1.61</b>	<b>1.18</b>	<b>1.10 – 1.28</b>

OR – odds ratio, AOR – adjusted odds ratio, CI – confidence interval, GI – gastrointestinal, ED – emergency department, IMD – index of multiple deprivation, <sup>§</sup>Comorbidity score based on the Deyo modification of the Charlson comorbidity score with the points for malignant disease deducted, <sup>\*</sup>Total number of ED visits in the last year of life, excluding the last 30 days. \*Rural – settlements with populations <10,000 and urban – settlements with populations ≥10,000. Figures in bold represent significant findings (p<0.01)

**Figure 2: Relationship between cancer patients' prior ED attendance and odds of multiple ED visits in the last 30 days of life**



Our multivariable model had a good overall fit (Hosmer-Lemeshow test  $\chi^2=8.78$ ,  $p=0.36$ ).

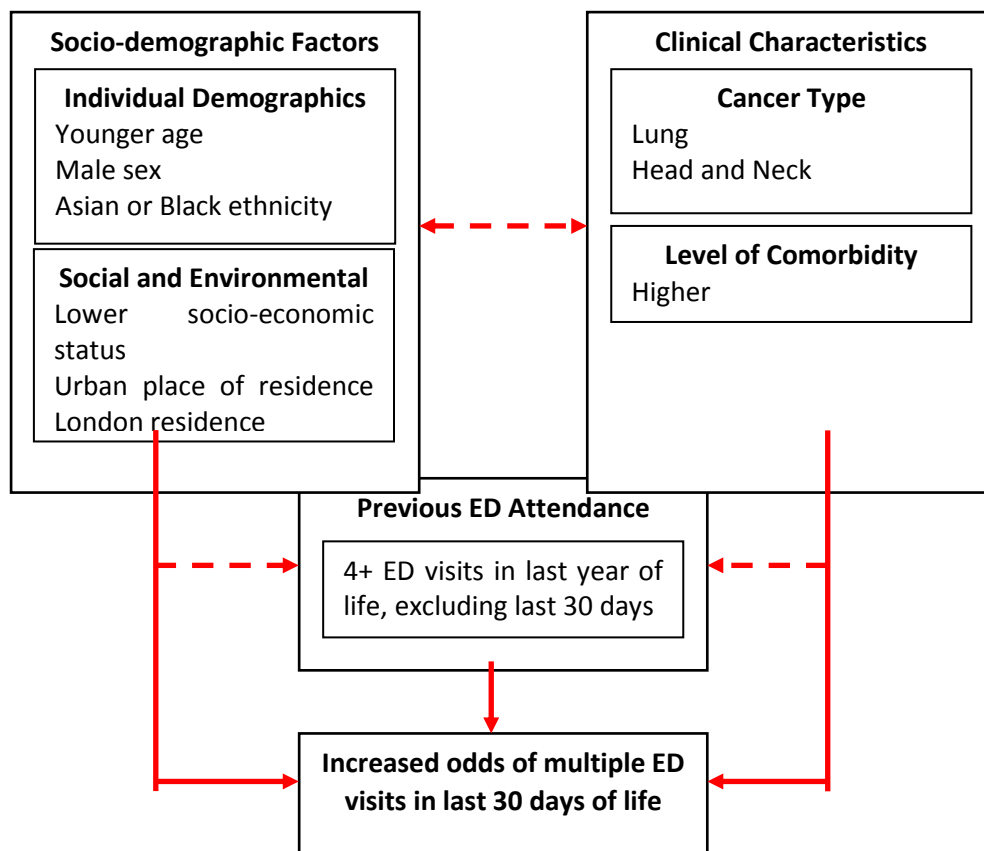
Discrimination performance, calculated as area under the ROC curve, was 0.64. All variance inflation factors were  $\leq 2.5$  (mean 1.6).

## DISCUSSION

In this population-based cohort study, we investigated socio-demographic factors and clinical characteristics associated with end-of-life ED visits, and explored the relationship between patients' prior ED use and the risk of multiple ED visits in the last month of life. We found a dose-response relationship between patients' prior ED use and their end-of-life ED visits, as well as an increased risk of multiple ED visits during the last month of life for patients with greater comorbidity and a diagnosis of lung or head and neck cancer. Previously reported socio-demographic factors (men;

younger age; Black ethnicity; low socio-economic status) were also confirmed for the first time in a UK population. Consistent with our study's theoretical framework, we found cancer patients' end-of-life ED visits were influenced by clinical, environmental and demographic factors. A theoretical model illustrating the relationship and potential interaction between factors has been constructed from the findings (figure 3).

**Figure 3: Theoretical model illustrating the relationship between factors and ED visits by patients with cancer in the last 30 days of life**



*Factors are listed under socio-demographic, clinical and previous ED attendance categories. Solid red lines indicate evidence from the present study of an association between factors and cancer patients' ED attendance. Hatched red arrows indicate an association between groups of factors based on existing evidence and/or theory, for example the relationship between patient age and cancer type.*

Our finding of a dose-response relationship between patients' prior ED use and their ED visits in the last month of life has not been previously reported in this population group. In prior work we have shown that patients receiving palliative care are less likely to visit the ED multiple times in the last month of life.(22) Furthermore, this reduction in odds appears to be greater when palliative care

services are provided earlier in a patients' course of illness.(41-43) Yet despite these findings many referrals to palliative care still occur late and prompts that encourage earlier engagement are desirable.(44) Multiple presentations to the ED could be used as a trigger for additional support services and may be a more effective method of identifying individuals at increased risk of overly aggressive end-of-life care than screening of multiple socio-demographic and/ or clinical factors.(44)

Our finding that patients with greater comorbidity are more likely to attend the ED multiple times is important. With the anticipated effects of population growth and ageing, the future average cancer patient will be older and likely to have  $\geq 1$  comorbidities.(45) With fewer hospital generalists and an overall trend towards increasing physician specialisation, collaboration between healthcare professionals is increasingly required when managing patients with multiple conditions.(46, 47) In order to deliver high-quality care to older more complex cancer patients, healthcare providers need to address the many well documented challenges associated with care coordination. Such challenges include: developing computer systems for effective communication and information sharing between services; providing timely and adequate information to patients and their caregivers; and, ensuring sufficient staffing and time.(48, 49)

We also found an association between multiple ED visits and a diagnosis of lung or head and neck cancer. The relationship between cancer type and use of acute healthcare services is often attributed to the pattern of disease spread and/ or typical profile of symptoms seen with certain malignancies.(50, 51) For example, patients with head and neck cancer are at risk of complications that can compromise their airway. Our finding that patients with lung cancer have an increased odds of multiple ED visits is consistent with previously published research (18, 21, 52, 53) and alludes to breathlessness being a particularly difficult symptom to manage. Traditional approaches towards managing breathlessness often focus on symptom relief, which although ideal, is more often than not unrealistic, especially for patients with incurable disease. In a recently published randomised controlled trial Higginson and colleagues evaluated a breathlessness support service against usual

care for 105 adults with refractory breathlessness and advanced disease (including cancer).(54) The primary aim of the intervention was to help patients cope with or “master” their breathlessness rather than improve overall breathlessness severity scores. This novel approach to symptom management may be one way of reducing end-of-life acute hospital service use secondary to breathlessness, although further evaluation is required.

We found that men, younger patients, Asian and Black ethnic minority groups, and persons of lower socio-economic status were more likely to visit the ED multiple times in the last month of life. These findings, reported for the first time in a UK population, support previously published studies from the United States and Canada and highlight the global extent of socio-demographic inequalities at the end-of-life.(18, 55, 56) Previous studies have explored whether this variation could be due to differences in patients’ understanding of their disease and prognosis or different preferences for end-of-life care across patient groups. (57-59) Whilst these studies have identified some important differences, the findings are unlikely to explain all the variation found. Further research aimed at understanding *why* such inequalities exist is urgently required.

Our study found a significant area effect for London residents, even after controlling for rurality, suggesting that healthcare service factors, not just clinical need, are important in determining patients’ ED use at the end-of-life. A number of recently published studies have reported evidence of an association between increased use of community services and a reduced odds of end-of-life ED visits, hospital admissions and death in hospital.(60-62) Despite these findings, recent austerity measures have led to reductions in many community healthcare services across England. The structure of healthcare services is especially important to consider, as unlike many other factors such patient demographics, it represents a modifiable component of care. To help inform future healthcare planning and policy further research investigating the relationship between end-of-life ED visits and patients’ use of community services is required.

### Strengths and Limitations

One of the main strengths of our study is the use of patient-level population data to investigate end-of-life ED visits by patients with cancer. ED visits do however represent only one indicator of end-of-life care quality and as such our findings should be considered alongside other quality measures such as patients' receipt of chemotherapy, use of hospice services and days spent in hospital or intensive care towards the end-of-life.(15)

Analysis of routinely collected data can be limited by the type of variables collected and the quality of data coding. ONS mortality data go through stringent quality assessments prior to becoming available which along with the use of automated coding software help maintain consistency and overall data quality.(63) Recording of the underlying cause of death is however based on information obtained from a patient's death certificate. Previous studies investigating death certificate completion have reported high levels of inaccuracy.(64) More recent evidence suggests this has improved and that deaths from cancer are more accurately reported than deaths from other conditions.(65, 66) We were not able to explore cause of death from the HES database. It is likely that our cohort included some patients whose cause of death was inaccurate, however the errors are not believed to have influenced our overall findings.

The HES Accident & Emergency dataset contained few clinical variables and many were unsuitable for analysis due to high levels of missing or invalid data (including the variable 'reason for ED visit'). There was also a lack of variables relating to patients' use of community services such as palliative care. With analysis of routinely collected data becoming increasingly common in healthcare research, addressing the validity and reliability of clinically coded variables is an important next step towards maximising the value of such resources.

Lastly, population trends can only ever be a guide for the care that any one individual will require at the end-of-life. In many situations the ED is the most appropriate setting for urgent care needs to be

managed and the importance of providing individualised patient-centered care should not be overlooked.

### **CONCLUSIONS**

Patients' with a greater number of prior ED visits, more comorbidities and diagnosis of lung or head and neck cancer are more likely to visit the ED multiple times in the last month of life. Previously reported socio-demographic factors (men; younger age; Black ethnicity; low socio-economic status) are also confirmed for the first time in a UK population. Flagging cancer patients who experience recurrent ED visits could support earlier identification of individuals at high-risk of overly aggressive end-of-life care. This may be a more effective and efficient approach than screening of multiple socio-demographic and/ or clinical factors.

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## **AUTHOR CONTRIBUTIONS**

**Conception and design:** Lesley A. Henson and Wei Gao, with critical revisions from Irene J. Higginson.

**Checking and cleaning of data:** Lesley A. Henson, supervised by Wei Gao.

**Data analysis and interpretation:** All authors.

**Manuscript writing:** Lesley A. Henson and Wei Gao with critical revisions by Irene J. Higginson.

**Final approval of manuscript:** All authors.

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